भारतीय मानक
Indian Standard

IS 13429 (Part 1) : 2020

सौर कुकर — बाक्स टाइप — विशिष्टि

भाग 1 अपेक्षाएँ

(दूसरा पुनरीक्षण)

Solar Cooker — Box Type — Specification

Part 1 Requirements

(Second Revision)

ICS 27.160; 97.040.20

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भारतीय मानक ब्यूरो
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May 2020 **Price Group 7**

Renewable Energy Sources Sectional Committee, MED 04

FOREWORD

This Indian Standard (Part 1) (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Renewable Energy Sources Sectional Committee had been approved by the Mechanical Engineering Division Council.

This standard (Part 1) was first published in 1992 and subsequently revised in 2000. While revising this standard based on the feedback received from various organizations connected with the solar cooking programme in the country all amendments have been incorporated and certain other changes which would help in implementing the Indian Standard in a better way.

The other parts of solar cooker standards simultaneously revised are as follows:

IS 13429 (Part 2) Solar cooker — Box type — Specification
Part 2 Components
Part 3 Test method

The solar cookers covered in this standard shall be of two grades A and B depending upon their thermal performance. The cookers with lower thermal performance value (F_1) designated as Grade B may be conveniently used in the regions like Gujarat, Madhya Pradesh, Maharashtra, etc, where solar intensity during the major part of the year is high. In Northern Region like Delhi, Haryana, Punjab, J&K, etc, where the solar intensity although in summer may be high but in winters the lower thermal performance (F_1) of cookers may not be adequate to cook the food due to poor solar intensity. For such reasons the use of cookers of higher thermal performance (F_1) designated as Grade A is recommended.

The composition of the Committee responsible for the formulation of this standard is given in Annex B.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off vale should be the same as that of the specified value in this standard.

Indian Standard

SOLAR COOKER— BOX TYPE — SPECIFICATION

PART 1 REQUIREMENTS

(Second Revision)

1 SCOPE

1.1 This standard (Part 1) specifies the requirements of box type solar cookers for cooking.

1.2 The solar cookers covered in this standard shall be of two grades depending upon their thermal performance (F_1).

a) *Grade* A — F_1 shall not be less than 0.12, and
b) *Grade B* — F_1 shall not be less than 0.11.

2 REFERENCES

The standards listed below contain provisions which through reference in this text, constitute provisions of this standard. At the time, of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
13429	Solar cooker — Box type — Specification
(Part 2) : 2018	Components (*second revision*)
(Part 3) : 2018	Test method (*second revision*)
IS/ISO 9488 : 1999	Solar energy — Vocabulary

3 DEFINITIONS

For the purpose of this standard the terminology and definitions given in IS/ISO 9488 shall be applicable.

4 COMPONENTS

4.1 The main components of box type solar cooker shall include the following :

a) Cooker box;
b) Handle;
c) Castor wheel;
d) Cover plate;
e) Metal frame for cover plate;
f) Plane glass cover plate;
g) Toughen glass cover plate;
h) Gaskets and grommets for cover plate and cooking tray;
j) Support for cover plate;
k) Cooking tray;
m) Cooking pots;
n) Mirror;
p) Mirror support;
q) Adjustable lever for mirror; and
r) Clips for holding adjustable lever.

4.2 The above list is for indicative purposes, manufacturer is therefore required, to submit full list of components included in their designed box type solar cooker before testing.

4.3 The Materials and other requirements of the components shall be guided by and shall conform to the requirements specified in IS 13429 (Part 2).

5 SHAPE

Typical shape of box type solar cooker is given in Fig. 1.

NOTE — The box type solar cooker may be of any other shape and design.

6 ASSEMBLY AND WORKMANSHIP

6.1 The entire assembly shall be free from surface defects. All sharp edges and corners shall be rounded off. The exposed surfaces shall be properly made corrosion resistant.

6.2 There shall be no direct contact between cooking tray and cooker box.

6.3 The top cover of the cooker box shall not cause any pressure either on the cover plate or on the mirror, also to protect the cover plate from damage during its thermal expansion.

6.4 The solar cooker shall be assembled so that replaceable components are easily accessible for repair or replacement.

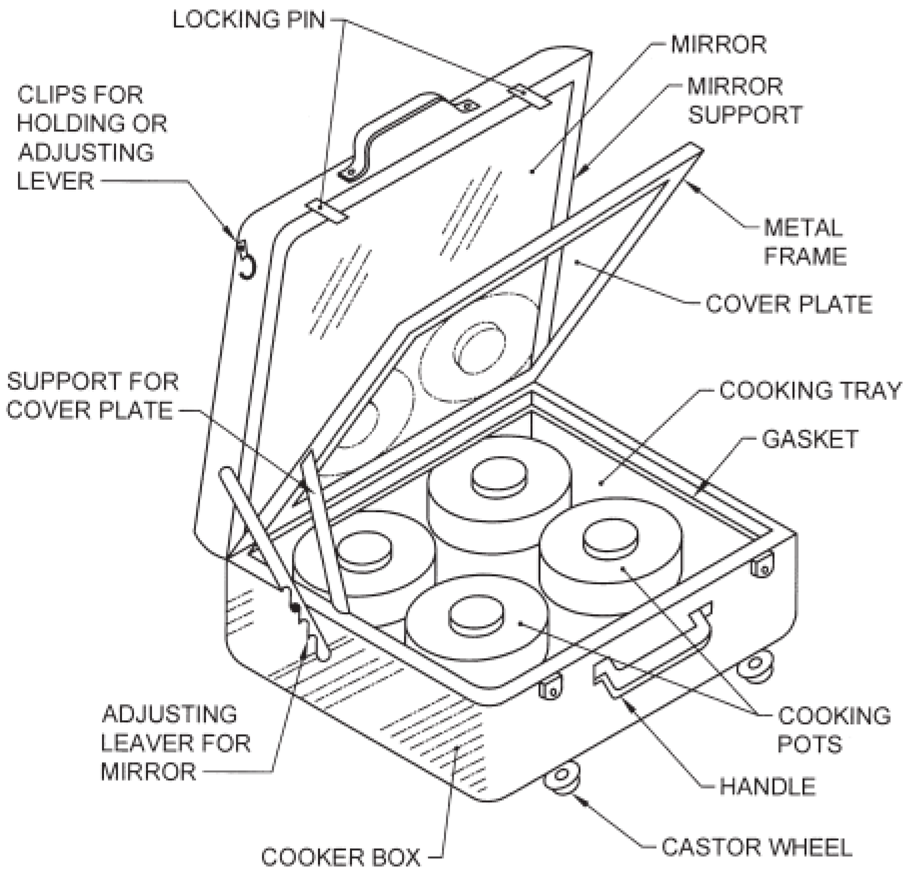

FIG. 1 SCHEMATIC OF A TYPICAL BOX TYPE SOLAR COOKER

7 TESTS

7.1 Following is the list of tests which need to be conducted on a sample box type solar cooker:

Sl. No.	*Test*		*Type of Test*	*To be Conducted*
i)	Leakage test:			
	a)	Cooking tray	Routine	On the finished solar cooker
	b)	Cover plate	Routine	On the finished solar cooker
	c)	Rubber gaskets	Routine	On the finished solar cooker
ii)	Slam test:			
	a)	Cover plate	Routine	On the finished solar cooker
	b)	Mirror	Routine	On the finished solar cooker
	c)	Any part of cooker	Routine	On the finished solar cooker
iii)	a)	Reflecting surface test	Routine	On the finished solar cooker
	b)	Shape retention test	Routine	On the finished solar cooker
iv)	Temperature test		Routine	On absorber sheet
v)	Transmittance test		Routine	On cover plate/ glass
vi)	Thermal shock test		Routine	On rubber and plastic components
vii)	Exposure test		Type	On the finished solar cooker
viii)	load test for FRP body		Type	On the finished solar cooker
ix)	Thermal performance test		Type	On the finished solar cooker
x)	Rain penetration test		Type	On the finished solar cooker

7.2 Sample Requirement Detail

7.2.1 A fully assembled unit of box type solar cooker along with the following components is required to carry out full scale tests contained in this standard to meet the durability, reliability and safety of box type solar cooker:

a) One piece of cooker box material total minimum area of 400 cm^2;
b) One piece of cooker tray material total minimum area of 400 cm^2;
c) One piece of cover plate frame about minimum length of 25 cm;
d) One piece of grommet about minimum length of 25 cm;
e) One piece of gasket / sealant of about 25 cm length;
f) Two numbers pieces of each assembly parts of solar cooker; and
g) Manufacturer's certificate in respect of *R* value of insulation material.

7.2.2 In addition, following is also required:

a) Information regarding, name of material of cooker box, name of material of cooking tray;
b) Name of material of cover plate frame, name of material of gaskets and grommets for cover plate and cooking tray;
c) Detail of assembling parts of solar cooker like castor wheel, glass, mirror, support for cooker box, cover plate and mirror, handling, lever, clips and other related parts. Detail of insulation like material name, manufacturing details with certificates.

7.3 Routine Tests

7.3.1 *Leakage Test*

The cooker tray, rubber gaskets and cover plate shall be subjected to the leakage test in accordance with **5.1** of IS 13429 (Part 3). There shall be no sign of leakage.

7.3.2 *Slam Test*

The cooker shall be subjected to slam test in accordance with **5.2** of IS 13429 (Part 3). There shall be no damage to cover plate, mirror or any part of cooker.

7.3.3 *Reflecting Surface Test*

The reflecting surface may be glass or metallic. The reflecting surface shall be subjected to reflectivity test in accordance with **5.3** of IS 13429 (Part 3). The glass reflecting surface shall have minimum 65 percent reflectivity. The metallic reflecting surface shall have minimum 80 percent reflectivity.

7.3.3.1 *Shape retention test*

The metallic reflecting surface shall be further examined for its shape retention. The flatness variation of the metallic surface shall not be more than ± 2 mm.

7.4 Type Tests

7.4.1 *Exposure Test*

The cooker shall be subjected to exposure test in accordance with **5.4** of IS 13429 (Part 3). There shall be no,

a) appearance of any sign of degradation of rubber or plastic material;
b) out gassing from the insulation material;
c) discoloration or peeling of black paint on the cooking pots and cooking tray;
d) deposition of water vapour, dust or any other material inside the cover plate when inspected visually; and
e) cracking of glazings and/or mirror and/or body of the cover.

7.4.2 *Load Test*

The cooker box made of fibre reinforced plastic shall be subjected to load test with 50 kg load kept on the box at the centre covering 50 percent of top surface area, for 1 h. No cracks shall appear on the box when inspected visually with naked eye.

7.4.3 *Thermal Performance Test*

The cooker shall be subjected to thermal performance test in accordance with **5.5** of IS 13429 (Part 3). The figure of merit F_1 shall be as mentioned below:

a) *Grade A* Cooker — F_1 shall not be less than 0.12.
b) *Grade B* Cooker — F_1 shall not be less than 0.11.
c) The figure of merit F_2 shall be greater than 0.40.

7.4.4 *Rain Penetration Test*

The cooker shall be subjected to rain penetration test in accordance with IS 13429 (Part 3). There shall be no sign of water vapour.

7.5 The test results of routine/type tests and of components covered in IS 13429 (Part 2) shall be reported by the independent laboratory in the proforma given at Annex A.

8 INSTRUCTION MANUAL

The manufacturer shall provide the instruction manual consisting of the following information:

a) How to use solar cooker;
b) Advantages and limitations;
c) General instructions for maintenance, trouble shootings and orientation of solar cooker;

d) Estimated boiling time for a standard load under specified climatic conditions as mentioned in IS 13429 (Part 3) and provided by the test centre;
e) Illustrative schematic diagram of the solar cooker;
f) List of names and addresses of manufacturers and suppliers of spare parts of box type solar cookers and also of repair facilities in the region; and
g) Information about the regions of the country where the cooker could be suitable for use.

NOTE — The cooker may also be supplied with the recipe book.

9 MARKING

9.1 The solar cooker shall be marked clearly and permanently with the following information:

a) Manufacturer's name and either initials or recognized trade-name, if any;
b) Serial number;
c) Country of manufacture;
d) Month and year of manufacture;
e) Mass of solar cooker, in kg;
f) Grade of the cooker (*see* **7.4.3**); and
g) Type of vessels for cooking (Stainless Steel or Aluminium) and their total capacity, in litre.

9.2 BIS Standard Mark

9.2.1 The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards* Act, 2016 and the Rules and Regulations framed thereunder, and the product(s) may be marked with the Standard Mark.

10 PACKING

The solar cookers shall be packed as agreed to between the purchaser and the supplier. The grade of the cooker shall be clearly marked on the package.

ANNEX A

(*Clause* 7.5)

PROFORMA

TEST REPORT FORMAT FOR BOX TYPE SOLAR COOKER AS PER IS 13429 (Parts 1, 2 and 3)

1 Name and Address of Manufacturer ………………………………………………....

………………………………………………….

………………………………………………….

Telephone : ………………………………………………..

Fax: …………………… e-mail………………………

2 Specifications of Solar Cooker and Testing Results

(All dimensions in millimetre, unless specified otherwise)

Sl No.	*Specifications/Tests*	*Specified Requirements*	*Results*
1	**Cover Plate [*see* 4.3 of IS 13429 (Part 2)]**		
1.1	Number of glazing	Two	
1.2	Material — Inner plate — Outer plate		Single piece glass Plain/Toughened Plain/Toughened
1.3	Spacing between outer and inner plate	10 ± 2	
1.4	Glass thickness, *Min* — Inner plate — Outer plate		
1.5	Solar transmittance of double glass lid at near normal incidence	65 percent, *Min*	
1.6	General appearance of glazing	Free from bubble/rough surface	
1.7	Aperture area		
1.8	Additional design feature	Provisions for keeping cover plate in inclined position	
2	**Cooking Tray [*see* 4.4 of IS 13429 (Part 2)]**		
2.1	Size		
2.2	Material	Al/Cu	
2.3	Thickness, *Min*	0.5	
2.4	Paint on inner surface	Matt black finish	
2.5	Temperature test for pain at 175°C for 1h	No deterioration of finished surface	

Sl No.	*Specifications/Tests*	*Specified Requirements*	*Results*
2.6	Scratch test after dipping of the painted surface in boiling water for 10 min [*see* **4.4.2.2** of IS 13429 (Part 2)]	No peeling of paint	
3	**Cooker Box [*see* 4.1 of IS 13429 (Part 2)]**		
3.1	Material	May be Al/Fibre glass/FRP/GS or SS/CRCA or HRC	
3.2	Thickness, *Min*	0.50, 3.00, 1.00, 0.80, 0.91 respectively if the above materials are used	
3.3	Size		
3.4	General finish	Smooth, even and free from sharp edges	
3.5	Performance test for cooker	As per requirement of **4.1.2.1** of IS 13429 (Part 2)	
3.6	Lock and latches of cooker	As per requirement of **4.1.2.2** of IS 13429 (Part 2)	
3.7	Impact test of cooker	As per requirement of **4.1.2.3** of IS 13429 (Part 2)	
4	**Gaskets and Sealant [*see* 4.5 of IS 13429 (Part 2)]**		
4.1	Material	Neoprene/EPDM/Silicone rubber	
4.2	Thickness, *Min*	2	
4.3	Thermal shock test [*see* **4.5** of IS 13429 (Part 2)]	No crack or brittleness	
5	**Insulation** **(A certificate regarding K-value and temperature test by the manufacturer shall be submitted) (*see* 4.6 of IS 13429 (Part 2))**		
5.1	Pad thickness: a) Sides and edges b) Back		
5.2	*K*-value at 100°C (as per certificate)		
5.3	Thermal resistance value (*R*) as calculated by dividing thickness of insulation used by K-value	0.96 m^2 °C/W *Min* and 0.58 m^2 °C/W *Min* for metallic and non-metallic body solar cookers, respectively	
6	**Mirror or Reflector [*see* 4.7 of IS 13429 (Part 2)]**		
6.1	General appearance	Free from bubbles/waviness	
6.2	Size		
6.3	Thickness, *Min*		
6.4	Solar reflectance [**5.3** of IS 13429 (Part 3)]	65 percent, *Min*	
6.5	Additional design feature	Provision for keeping the mirror in inclined position	

Sl No.	*Specifications/Tests*	*Specified Requirements*	*Results*
7	**Cooking tray [*see* 4.4 of IS 13429 (Part 2)]**		
7.1	Material	Al alloy/ SS	
7.2	Thickness		
7.3	Number		
7.4	Depth		
7.5	Diameter		
7.6	Total capacity of the pots in litres		
7.7	Coating on outside surface	Matt black finish	
7.8	Coating on bottom	No coating	
7.9	Temperature test for paint at 175°C for 1h	No deterioration of finished surface	
7.10	Scratch test after dipping of the painted surface in boiling water for 10 min [*see* **4.4.2.2** of IS 13429 (Part 2)]	No peeling of paint	
8	**Caster Wheels (Optional) [*see* 4.9 of IS 13429 (Part 2)]**		
8.1	Number	Four	
8.2	Construction	Having ball bearing. Alternatively, two cylindrical supports for front, and two wheels for rear, all made of plastic or non-corrosive material	
8.3	Test on castor wheels	As per requirement of **4.9.1.1** of IS 13429 (Part 2)	
9	**Workmanship and Finish of Components [*see* 4.10 of IS 13429 (Part 2)]**		
9.1		a) All surfaces smooth and free from roughness, raised spots, scale or any other defects b) Sharp edges and corners rounded off c) Screws, hinges, lever rods, locks, handle, caster wheels, etc, properly fitted d) Weight of components set in such a way that the cooker does not topple back when opened for its loading/unloading	
10	**Assembly of Component [*see* 6 of IS 13429 (Part 1)]**		
10.1		a) Replaceable components are easily accessible for repair/ replacement b) There is no direct contact between tray and cooker box c) Top cover of the cooker box causes no pressure either on cover plate or on the mirror	

Sl No.	*Specifications/Tests*	*Specified Requirements*	*Results*
11	**Routine Tests**		
11.1	Cooking tray leakage test [*see* **5.1.1** of IS 13429 (Part 3)]	No sign of leakage	
11.2	Rubber gasket leakage test [*see* **5.1.2** of IS 13429 (Part 3)]	No sign of leakage	
11.3	Leakage test for upper side of cover plate [*see* **5.1.3**(a)of IS 13429 (Part 3)]	No sign of leakage	
11.4	Leakage test for lower side of cover plate [*see* **5.1.3**(b) of IS 13429 (Part 3)]	No sign of leakage	
11.5	Rain penetration test [*see* **5.1.4** of IS 13429 (Part 3)]	No sign of entry of water vapour	
11.6	Slam test [*see* **5.2** of IS 13429 (Part 3)]	No damage to cover plate, mirror or any part of cooker [*see* **7.3.2** of IS 13429 (Part 1)]	
11.7	Reflecting surface test [*see* **5.3** of IS 13429 (Part 3)]	65 percent, *Min* [*see* **7.3.3** of IS 13429 (Part 1)]	
11.8	Shape retention test	As per requirement of **7.3.3.1** of IS 13429 (Part 1)	
12	**Type Tests**		
12.1	Exposure test [*see* **5.4** of IS 13429 (Part 3)]	a) No appearance or any sign of degradation of rubber or plastic material b) No outgassing from the insulation material c) No discoloration or peeling off of the black paint on cooking pots and cooking tray d) No deposition of water vapour, dust or any other material inside the cover plate when inspected visually e) No cracking of glazing and/or body	
12.2	Load test for FRP body cookers only [*see* **7.4.2** of IS 13429 (Part 1)]	No appearance of any cracks on the box when inspected visually with naked eye	
12.3	Thermal performance test, *Min* [*see* **5.5** of IS 13429 (Part 3)]		
12.3.1	Stagnation temperature test	F_1 not less than 0.12 for Grade A solar cooker F_1 not less than 0.11 for Grade B solar cooker	

Sl No.	*Specifications/Tests*	*Specified Requirements*	*Results*
12.3.2	Load test: Sensible heating of water	F_2 greater than 0.4	
12.3.3	Standard boiling time	Enclose a graph showing the variation of t_{boil} in minutes with as shown in Fig. 2	
13	**Marking and Packing Details**		
13.1		a) Manufacturer' name/initials/ recognized trade-name b) Serial Number c) Country of manufacture d) Month and year of manufacture e) Mass of solar cooker f) Grade of solar cooker g) Type of vessels for cooking and their total capacity in litres	
14	**Handle and knob test**		
14.1	Material of Handle and knob [*see* **4.2.1** of IS 13429 (Part 2)]	SS/brass, etc	
14.2	Material of rivet [*see* **4.2.2** of IS 13429 (Part 2)]	Al etc.	
14.3	Maximum temperature rise of handle/ knob material	As per requirement of **4.2.3** of IS 13429 (Part 2)	
14.4	Creep test	As per requirement of **4.2.4.1** of IS 13429 (Part 2)	
14.5	Fatigue test	As per requirement of **4.2.4.2** of IS 13429 (Part 2)	

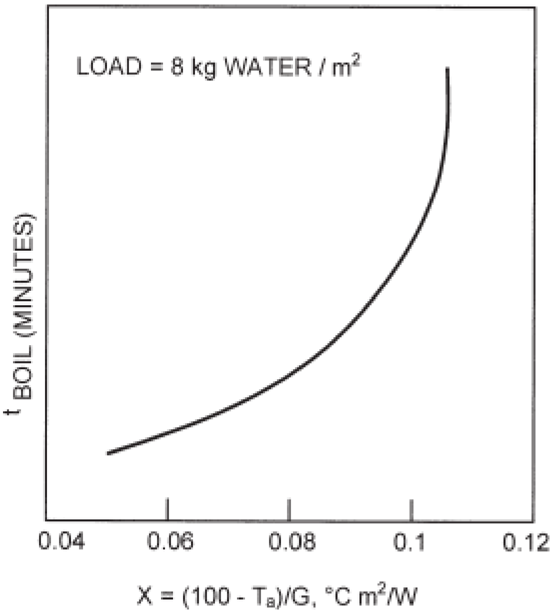

Fig. 2 Graph Showing the Variation $t_{\text{boil (IN MINUTES)}}$ with $X = 100\text{-}T_a / G$

3 TEST DATA

3.1 Curves showing the time variation of tray temperature, solar radiation intensity and ambient temperature during the no load test (with date) for all the three valid sets of readings used in deriving the value of F_1, shall be presented.

3.2 Curves showing the time variation of water temperature in the largest cooking pot, solar radiation intensity and ambient temperature for all the three valid sets of readings used in deriving the value of F_2 shall be presented.

3.3 The average value of wind speed during the measurements shall also be reported with each of the above set of test data.

4 BOILING TIME (T_{BOIL})

Table 1 shall be deduced using the test values of F_1 and F_2 for the conditions of solar intensity and ambient temperature corresponding to a load of 8 kg of water/m^2 aperture area of the solar cooker. It may be noted that the actual boiling time shall be less than the values indicated in Table 1 on account of the use of reflecting mirror in appropriate inclination/orientation

Table 1 Boiling Time as Deduced Using Test Values of F_1 and F_2 for the Test Cooker for Standard Conditions for a Load of 8 kg of Water/m^2 of Aperture Area

(*Clause* A-4)

Sl. No. (1)	Solar Intensity (W/m^2) (2)	Ambient Temperature (^{O}C) (3)			
i)	↓	10	20	30	40
ii)	400				
iii)	500				
iv)	600				
v)	700				
vi)	800				
vii)	900				

Date **Authorised Signatory**

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ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

Renewable Energy Sources Sectional Committee, MED 04

Organization	*Representative(s)*
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Biogas Forum India, New Delhi	Dr A. R. Shukla
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Central Mechanical Engineering Research Institute, Durgapur	Shri Bhoplab Choudhary Shri Siva Prakashris (*Alternate*)
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EMMVEE, Bengaluru	Shri Vijay Kumar C. R.
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Indian Renewable Energy Development Agency Ltd, New Delhi	Shri B. M. Chauhan Shri Sompal (*Alternate*)
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Maharashtra Solar Manufacturers Association, Pune	Shri Suhas Ghotikar Shri Mangal Akole (*Alternate*)
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Regional Test Centre, Pune	Prof (Dr) Sandesh R. Jadkar Dr Anagha M. Pathak (*Alternate* I) Dr Adinath Funde (*Alternate* II)
Regional Test Centre, Indore	Dr S. P. Singh Prof R. N. Singh (*Alternate*)

Organization	*Representative(s)*
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Solar Energy Society of India, New Delhi	Shri A. P. Shrivastava Shri Rajinder Kumar (*Alternate*)
Solchrome Systems India Limited, Parwanoo	Shri K. K. Singla
The Energy and Resources Institute, New Delhi	Shri Girishri garud Dr Ishan Purohit (*Alternate*)
The Maharashtra Energy Development Agency (MEDA), Pune	Shri Manoj A. Pise Shri H. Manik Kulkarni (*Alternate*)
In personal capacity (*C*-103 *A*, *JVTS Garden Chaterpur Extention, New Delhi* 110074)	Shri Atam Kumar
BIS Directorate General	Shri A. Renga Rajan, Scientist 'E' and Head (MED) [Representing Director General (*Ex-officio*)]

Member Secretary

Shri Chandan Gupta
Scientist 'C' (MED), BIS

Solar Thermal Energy Sub-Committee, MED 04:1

Organization	*Representative(s)*
Regional Test Centre, Indore	Dr S. P. Singh (***Convener***) Prof R. N. Singh (*Alternate*)
Bharat Heavy Electricals, Hyderabad	Shri M. R. Pawar
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Karnataka Solar Manufacturers Association, Bengaluru	Shri A. Palani

Organization	*Representative(s)*
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Maharashtra Solar Manufacturers Association, Pune	Shri Suhas Ghotikar Shri Mangal Akole (*Alternate*)
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